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MATERIAL AND SURFACE SCIENCE

Investigations on Polytypic Growth of Silicon Carbide

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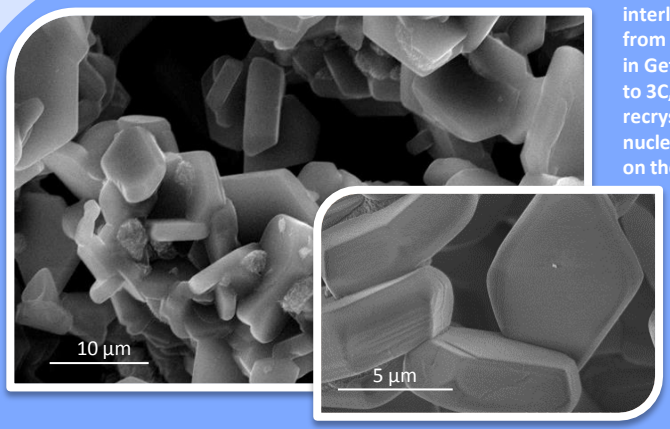
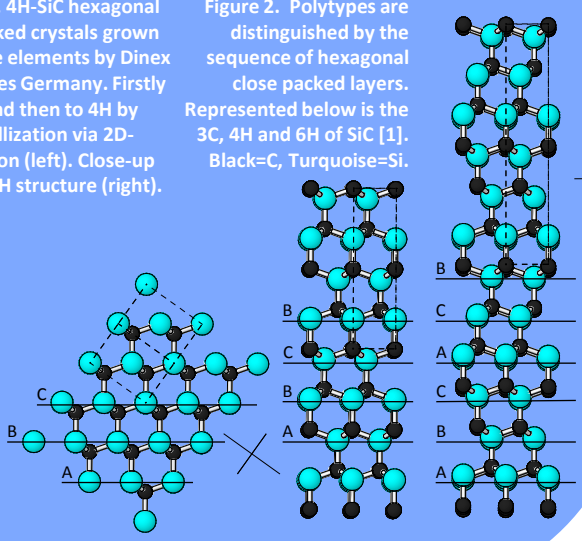


Figure 1. 4H-SiC hexagonal interlocked crystals grown from the elements by Dinex in Gefrees Germany. Firstly to 3C, and then to 4H by recrystallization via 2D-nucleation (left). Close-up on the 4H structure (right).

Figure 2. Polytypes are distinguished by the sequence of hexagonal close packed layers. Represented below is the 3C, 4H and 6H of SiC [1]. Black=C, Turquoise=Si.



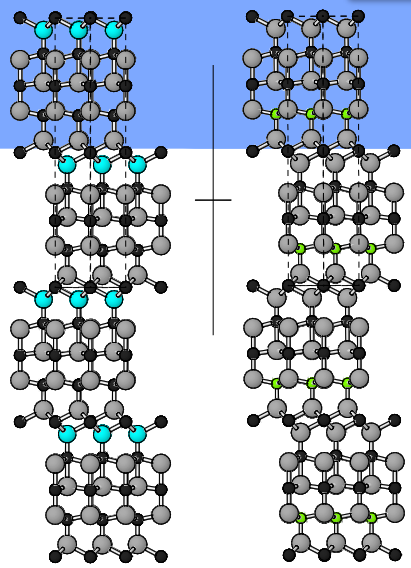


Figure 3. Al_4SiC_4 (Al_4C_3·SiC) (left) is isostructural to Al_5C_3N (Al_4C_3·AlN) (right) and crystallizes only under conversion from 3C-SiC to 4H-SiC [1]. Grey=Al, Black=C, Turquoise=Si, Green=N.

- **Silicon carbide exists in more than 250 polytypes; 3C and 6H being the most common. 4H can be grown only by sintering the elements together with aluminium [2-5].**
- **Pyrolysis under nitrogen at 850 °C, and sintering under argon to 1980 °C, results in platy crystals of 4H silicon carbide and yellow hexagonal flakes of $Al_4SiC_4 – Al_5C_3N$ solid solution.**
- **We believe that aluminium atoms are adsorbed on the $\{00\bar{1}\}$-face of the silicon carbide crystals, yielding ternary carbides. These serve as intermediate compounds for promoting the growth of 4H-SiC due to the resemblances in their structure.**

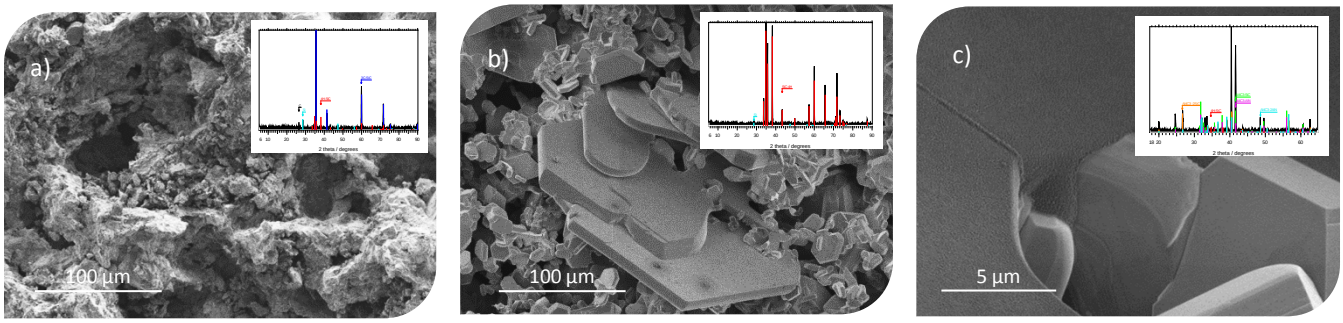


Figure 4.
a) SEM micrographs of 3C-SiC after pyrolysis under nitrogen at 850 °C and sintering under argon to 1650 °C.
b) 4H-SiC intergrown with ternary carbides after the final sintering at 1980 °C. The 3C to 4H transition does not arise when sintering under nitrogen.
c) Close-up of the junction between silicon carbide and the ternary compounds.
The inserts show powder XRD-patterns of 3C, 4H and ternary carbides respectively.

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